

errors in Dr. Tyndall's popular works; and to join the too thin ranks of those who, like Mr. Sedley Taylor, are not to be imposed upon by a popular reputation—but venture to think for themselves and to give the public the benefit of the result.

8. Opportunities for such public warning have never been wanting, but now they are so numerous that a long essay would be requisite to do justice to them all.

In the meantime, as an example or two, I may call attention to the way in which Sir Charles Wheatstone, and (by implication) Sir William Thomson, and others, some of whose splendid scientific labours have had the misfortune to become profitable in a pecuniary sense, are treated in Dr. Tyndall's "Lectures on Light," just published. The contrast between the utter contempt for money shown by their censor, and the (implied) opposite which is condemned as unworthy of scientific men, is brought out with all the flow of word-painting and righteous indignation which Dr. Tyndall so abundantly possesses. Besides, the monstrous doctrine is inculcated that men who devote themselves to practical applications are men incapable of original research.

9. But, to conclude for the present, I would simply call attention to the following passage, which comes from an author who in the same work treats of the relative merits of such giants as Young and Fresnel. What confidence can one have in the accuracy of any statement on a scientific matter made by the author of it?—

"And here we may devote a moment to a question which has often been the subject of public discussion—whether, namely, a rainbow which spans a tranquil sheet of water is ever seen reflected in the water? Supposing you cut an arch out of paste-board, of the apparent width of the rainbow, and paint upon it the colours of the bow; such a painted arch, spanning still water, would, if not too distant, undoubtedly be seen reflected in the water. The coloured rays from such an arch would be emitted in all directions, those striking the water at the proper angle, and reflected to the eye, giving the image of the arch. But the rays effective in the rainbow are emitted only in the direction fixed by the angle of 41° . Those rays, therefore, which are scattered from the drops upon the water, do not carry along with them the necessary condition of parallelism; and, hence, though the cloud on which the bow is painted may be reflected from the water, we can have no reflection of the bow itself."—"Lectures on Light," p. 25.

If Dr. Tyndall, with the assistance of his scientific advisers, fails to see the justice of my remark on this passage, perhaps you will permit me to make it the text of a little essay in a future number.

I have all along said, and still say, that I cordially recognise the services of Dr. Tyndall in popularising certain parts of Science. But his readers must be cautioned against accepting as correct great parts of what he has written. It is granted to very few men to do this useful work without thereby losing their claim to scientific authority. Dr. Tyndall has, in fact, martyred his scientific authority by deservedly winning distinction in the popular field. One learns too late that he cannot "make the best of both worlds."

I would request Dr. Tyndall for his own sake, not for mine, should he favour me with a reply, not to pick out one or two isolated passages of a letter, which absence from books may possibly have rendered slightly inaccurate—but to answer me, as he has not answered Forbes, in the full spirit and not in the partial letter.

St. Andrews, Aug. 20

P. G. TAIT

W. S. J. on Hegel

I RESPECTFULLY request admission, into an early number of NATURE, for an explanatory word or two, in reference to W. S. J.'s review of my poor book on Law, &c., in the valuable publication named, for July 24, 1873.

W. S. J.'s very first sentence speaks of the said little book as containing "a discussion of Hegel's opinions concerning gravitation and the differential calculus." In the first place, Hegel has nothing to say against either gravitation as a fact, or the differential calculus as an established method of indubitable scientific calculation: he would only attempt to philosophise both by placing metaphysical principles under them. Now this is part of Newton's own action, and he certainly would not object to any attempt, Hegel's or other, in the same direction. In the second place, I discuss no opinion of Hegel in this reference: I only attempt to expose erroneous opinions of Hegel's relative

opinions. To this I strictly confine myself, and this goes much deeper than the reader may, at first, think.

On Law, whatever is said by W. S. J., concerns only the old difficulty of Hegel's *dialectic*; and perhaps the italicising of this word, together with my own intellectual deficiencies, may be respectfully offered in explanation of as much. W. S. J. here, then, is evidently misintelligent himself, and, accordingly, only speaks so as to induce misintelligence in others. Nevertheless, it is worth saying that the reader may or may not gain from the particularity of satire in W. S. J.'s hands—so keen is it that it cows, and, again, so kindly that it disconcerts.

Mathematically, according to W. S. J., "the critical statement of the necessary outcome of Hegel's philosophy," reduces itself to this, that the principle in question is placed "in that in which the quantum has disappeared, and there remains the relation only as qualitative relation of quantity." W. S. J. has for this only the mildly-authoritative contempt of a duly-elevated position; and when it is said "What is called infinitely little is only qualitative, and is neither little nor great, nor quantitative at all," he at once squelches all by an "on the contrary!" Now all this condemned matter comes directly, not from Hegel, but from Newton; for the former, quoting from the latter, says:—

"These (N.'s increments and decrements) are not to be taken as particles of a definite magnitude (*particula finita*). Such were not themselves moments, but magnitudes, generated out of moments; what is to be understood, rather, is the principles or beginnings (elements) of finite magnitude;" that is, plainly, what is concerned lies "in that in which the quantum has disappeared as quantum, and there remains the relation only as qualitative relation of quantity."

What concerns comets is naively amusing. We have not had to wait in their regard (as W. S. J. seems to think) for the information of "Chambers' Handbook." The astronomers of the last century, as it appears, were able to speak better than even the "Handbook." Comets that return, they say, though after a great many years, travel in ellipses of enormous axes; whereas those that do not return may describe parabolas or hyperbolas. Such is the opinion of Science yet, though it may talk of many other explanations of non-return, as dissipation, interception, &c. This, I say, is how Science looks yet; but W. S. J., for his part, is under the belief that Science has actually within its ken comets that (so to speak) *revolve* in hyperbolas, as well as others that revolve in ellipses. (Positively such seems his idea. Now, Hegel is never once at fault here—in his own way, I mean; for whether in ellipse, in parabola, or hyperbola, Hegel's assignation of the moment of singularity to the comet is, on his own principles, justifiable. May not a non-returning comet, too, be attributed to that contingency which is, and must be, inherent in externality as externality? On the whole, it may be well for us all to let comets alone yet. Our greatest living authority can only philosophise them into stone-rattles which the sun (for his amusement?) whirls about his head.

One has only to consider these things and others the like—the exquisite little gibes, not forgotten, about a secret in two volumes and a secret in fifteen pages, &c.—to perceive that what we have here is only once again the blind rush of prejudice from its usual dark corner of relative ignorance—an ignorance which it will persist in, and not (through study) convert into the light of day. There is that approbative allusion to Mr. Smith, too; W. S. J. will yet be ashamed of that.

On the whole, however, I hope I have not spoken disrespectfully, for I cannot fancy who W. S. J. may be. He talks of law and logic, and is possibly a lawyer; he certainly has a profound contempt for "Hegel and his satellite Stirling;" but were he (what his initials may indicate) "the eminent Jagers" himself, I cannot, whatever his power of *practice*, admire his capacity for *principles*.

Edinburgh, July 28

J. HUTCHISON STIRLING

Lakes with two Outfalls

IN NATURE, Aug. 14, a paper under this heading concludes thus:—"Colonel George Greenwood, who is, I presume, the same as the former active correspondent about this subject, visited this lake (Lesjeskaugen) last summer, as appears from the entry of his name in the day books. I am not aware that he has since published any opinion, but the lake seems, so far as I can judge, to support his view of the matter.—W. Stanley Jevons." I sent an account of my visit to Lesjeskaugen Lake

to the *Geological Magazine* in July 1872, but it was not so fortunate as to meet with acceptance from the editor. The following extracts coincide singularly with the opinions of Prof. Stanley Jevons:—

The river Rauma, at the western end, which gives its name to Romsdal, is the *natural* outlet. The outlet to the river Logen, at the eastern end, is entirely *artificial*. The water-parting there, between Romsdal and the Dovre Feld, is an ancient ridge of drift. A cut has been made by man through this ridge. The stream through this cut now works a saw mill, but was formerly connected with the old iron works. The one outlet from the lake enters the mill pool, from which there are two outlets, one to serve the mill the other for the waste water. All these three outlets are kept each at its required level *artificially*, that is, with piles, logs, boulders, and rubble, so that the quantity of water which is let out of the lake is regulated by 'the miller and his men.' The case is precisely equivalent to the Black Loch, in Dumfriesshire, whose *natural* (!) outlet is an iron sluice in a stone dam opening to a mill lead cut through the water-parting to Lord Bute's mill. (See *Athenæum*, Aug. 6, 1864, and 25 in. Ordnance maps.) If such lakes as these are lakes with two outlets, then the new conduit for the water supply of Glasgow makes Loch Katrine a lake with two outlets. An old dry channel is in direct continuation of the present mill lead. It passes so close to the old iron work as actually to touch its base. If, as I imagine (as does also Prof. Stanley Jevons), the two are connected with each other in origin, the artificial outlet to the lake may be of very great antiquity.

A notice in *NATURE*, of a new work by Capt. Burton (1872), quotes these words of his: "The northern and north-western portions of the so-called 'Victoria Nyanza' must be divided into three independent broads or lakes . . . in order to account for the three effluents, within a little more than sixty miles." Here, then, the great traveller adopts my dictum, that "a lake can only have one outlet." I first published this dictum in the *Athenæum*, July 4, 1863, when the late lamented Capt. Speke, in his "Sketch Map," gave four outlets to Lake Victoria Nyanza, three on "native information;" and in the *Athenæum*, July 25, I said, "I think that the native information will prove to be erroneous."

GEORGE GREENWOOD

Brookwood Park, Alresford, Aug. 15

As Prof. Jevons has revived the question of the existence of lakes possessing more than one outlet, I would invite the attention of your readers to what appears to me an unequivocal instance of the kind, though on a small scale, in the neighbourhood of the place whence I write.

On the high and very broken ground between the old mountain road from Dolgelly to Towyn (which runs at the foot of Cader Idris) and the south shore of the estuary of the Mawddach is a watershed, which separates streams flowing directly into the estuary by Capel Arthog from others which, after joining the stream that descends from Llyn y Gader in the hollow immediately under the summit of Cader Idris, find their way into the estuary some three miles higher up. On this watershed lies a lake about half-a-mile long, named Llyn Creigenen, which occupies a rock basin with two lips at exactly the same level, one at its western, the other at its eastern extremity. By the western lip a small stream issues which descends rapidly and at one part of its course forms one of the branches of the Falls of Arthog, well known to visitors at Barmouth. By the eastern lip also, a stream, diminutive, it is true (at any rate in the summer months), but still quite distinct, issues and descends into a boggy tract, along which it wanders for some two miles, until it joins the stream before mentioned from Llyn y Gader. These facts are distinctly recorded on the Ordnance map, and I have frequently verified them myself and pointed them out to others. I think there can be no doubt but that in this instance both of the outlets are *natural*, and that a stream must issue from one if a stream issues from the other, at any rate at the ordinary level of the water in the lake. It is perhaps, impossible to say that both outlets are *permanent* in that *secular* sense which Prof. Jevons seems to attribute to the word, as circumstances are easily conceivable under which the flow through the smaller easterly outlet might cease; but at any rate for many years, supposing the average supply of water to the lake to remain the same, and no artificial barrier to be erected, the two streams will continue to issue from the lake at all seasons.

Prof. Jevons remarks that "on *à priori* grounds it seems very unlikely that there should exist any lake with two distinct outflows." I would reply that, while it is undoubtedly improbable

that any particular lake named at random should possess this characteristic, it can hardly be regarded as *à priori* very unlikely that among all the lakes on the earth's surface there should be found here and there one with more than a single outlet. At any rate, I would recommend anyone who is sceptical in the matter to visit Llyn Creigenen, which is but an easy hour's walk from the Arthog Station on the railway between Barmouth Junction and Dolgelly.

ROBERT B. HAYWARD

Capel Arthog, Aug. 16

Cranes in the Gardens of the Zoological Society of London

IN *NATURE* of June 26 (*antea*, p. 164), Mr. W. A. Forbes points out an error in the report of the meeting of the Zoological Society for June 15, in a statement that no example of *Grus vipio* (*sive leucauchen*) had been brought to Europe previously to those lately received by that Society. Instead of "Europe" the word "England" should have stood in the paragraph in question, which would then have been correct.

It is quite true (as stated by Mr. Forbes) that the collection of living cranes in the Gardens of the Zoological Society of Amsterdam is the finest in the world. At the same time the series of these birds in the Regent's Park is also at the present moment very nearly perfect, embracing, as it does, examples of all the usually recognised species, with the exception of *Grus leucogeranus*, and *G. monacha*.

Of the former of these the Society once possessed a living specimen, but the rare *G. monacha* of Japan has, I believe, never yet reached Europe alive.

The following is a list of the Zoological Society's present series of the Gruide:—2 Common Cranes (*Grus cinerea*), 1 Brown Crane (*G. canadensis*), 2 White-necked Cranes (*G. leucauchen*), 1 Sarus Crane (*G. torquata*), 1 Australian Crane (*G. australasiana*), 1 White American Crane (*G. americana*), 1 Manchurian Crane (*G. montignesia*), 2 Wattled Cranes (*G. carunculata*), 1 Balearic Crowned Crane (*Balearica pavonina*), 4 Cape crowned Cranes (*B. regulorum*), 3 Demoiselle Cranes (*Anthropoides virgo*).

August 27

P. L. S.

Colour of Lightning

I SHOULD be much obliged to any of your readers who would give me any information as to the cause of the colour of lightning.

In one of two storms which passed over here yesterday evening the lightning was decidedly pink in tint; later in the night it had regained its normal yellow or bluish colour.

Odrey, Aug. 25

H. GEORGE FORDHAM

Harmonic Causation and Harmonic Echoes

IN reference to the question of "Harmonic Echoes," allow me to suggest to those who may have the opportunity of observation, how desirable it is that these echo-tones should be investigated in a manner to determine whether they are truly harmonic or not. There would be no difficulty in testing the sounds given in response to the notes of a closed organ-pipe and an open one, or the notes of representative musical instruments, clarinet and flute. It might be found that the echo at Bedgebury Park would give the octave always, irrespective of the particular instrument provoking it; or, on the other hand, that it refused to answer to a closed pipe, or gave only the twelfth, its proper reply. We should then know whether the echo-tone was that of the harmonic or a new fragmental tone consequent on the breaking up of the wave of the fundamental or ground-tone, by "breakers ahead."

Now that we are called upon to recognise several varieties or classes of musical tone, it is time that the leaders in Science came to a general agreement upon the use of the term "harmonic." Is it to be applied indifferently to "over-tones," otherwise "partial-tones," to "combination-tones," to "concussion-tones," arising from the violence of the shock of sound-waves in collision, to "fragmental-tones" produced out of the wave of the ground-tone broken up by obstacles encountered in its course or in reflection, and to "echo-tones" which may be affiliated to either variety? It seems to me that we risk much confusion unless "harmonic" is restricted to its earlier usage, and applied solely to the "harmonic series,"—the tones which are the direct offshoots of the fundamental. These tones have but one order of succession, and will bear no interpolation: the